

ETIOLOGY OF EMBOLISM.*

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Embolism is the transportation of the insoluble substance in the blood or lymph current, and its lodgment in some part of the vascular apparatus, more or less remote from its point of departure. The term is generally applied to this process when observed in the arteries, veins or capillaries, and it is embolism of this kind which is the subject of this evening's discussion.

The substance transported by the blood and lodged in a vessel is called an embolus from the Greek word *embolus*, signifying a stopper or plug, and it may be either solid, liquid or gaseous.

It is frequently composed of fibrin derived from a softened thrombus, but it may consist of any insoluble material which finds its way into the circulating blood. Fat globules, fragments of vegetations, aggregations of blood pigment, parasites, fragments of tumors, the detritus of cells in renal, splenic or hepatic abscess, groups of bacteria, in pyemia and malignant endocarditis, and air or gas bubbles also act as emboli.

An obliterating embolus is one which completely occludes the vessel in which it lodges and is, generally globular in form, although it may be elongated or irregular in shape. A straddling embolus is one which, being caught at the bifurcation of an artery, is propelled into both secondary vessels, more or less completely obstructing them.

Emboli may be further classified as bland and infective.

The former act only mechanically, and do not produce inflammation of the obstructed vessels or of surrounding tissues. The latter (infective emboli), contain pathogenic organisms and produce, besides mechanical effects, various chemical ones, leading to inflammatory and degenerative changes in the vessels of the adjacent tissues. Direct embolism is that variety in which the embolus is transported in the direction of the normal blood current, and is most common. In retrograde embolism, the embolus passes in the direction opposite to the normal blood current, as in tricuspid regurgitation into the *venæ cavæ*. Paradoxical embolism is the transportation of emboli from the veins into the arterial system, without passing through the pulmonary circulation, as in the case of a patulous foramen ovale.

In direct embolism, the embolus is borne along by the blood current until the channel becomes too narrow to admit of its passage, or until it encounters some insurmountable obstacle to its further progress. In direct embolism, the vessels obstructed are arteries, since they diminish in calibre, as they pass to the periphery, or they are capillaries, if the embolus is microscopic. The one exception to this rule is the portal vein, the centripetal radicles of which are smaller than the parent vessel.

Embolism due to the detachment of parts of

a thrombus is primarily due to those processes favoring thrombus-formation, such as endarteritis phlebitis, hypercoagulability of the blood, or notable retardation of the blood current.

Embolism from the entrance of fat globules into the circulation is occasioned by injuries or diseases of bones involving the medulla, as in fractures, amputations, or osteo-myelitis, but it may follow the disintegration of any organ containing fatty tissues, as the breast, the liver or brain. Fat embolism usually occurs in the pulmonary capillaries, but may be found in the vessels of the heart, kidneys, brain and spleen, the emboli, in that case, having been sufficiently diminutive to pass through the capillaries of the lung, on their way to their ultimate destination.

Embolism of the capillaries and of the smaller arteries is also occasioned by the development, in the blood, of the *filaria sanguinis hominis*, of the *plasmodium malariae* and of the *bilharzia hematobia*. Embryonic trichinae, amebae and various bacteria may produce embolism of the liver capillaries.

Air embolism is usually caused by the entrance of air into the large venous trunks of the neck through wounds, or during operations on the neck, face or chest, but the air may enter the circulation through the uterine venous radicles, in abortion or placenta previa, after the separation of the placenta, or may find its way through veins opened by ulceration of the stomach or of the intestines.

Caisson disease is supposed, by some authorities, to be occasioned by emboli composed of free nitrogen liberated in the blood and carried into the capillaries of various vital organs, when the workmen pass, too suddenly, from the condensed air of the caisson into the comparatively rarified atmosphere of the outer world.

Gaseous embolism may also be caused by infection with gas-producing bacteria, as the *bacillus aerogenes capsulatus*.

Pigment embolism occurs in malarial fever, lending to pernicious types of that disease their characteristic features, and it is a possible complication of melanotic neoplasms of the liver and of other organs.

Retrograde embolism may occur in the *vena cavæ*, the hepatic veins, or in those of the upper extremities and of the head, as the result of tricuspid regurgitation caused by dilatation of the right ventricle and auricle. Retrograde embolism has also been reported in the hepatic, mesenteric, pulmonary, renal and coronary veins, as well as in the cerebral sinuses.

The cause of paradoxical embolism is the post-natal patulousness of the foramen ovale and of the ductus Botalli, which permits the passage of emboli from the right ventricle directly to the left ventricle, or to the aorta. These emboli may be derived from thrombi in the right auricle, the *venæ cavæ*, or elsewhere, and, having passed into the aorta, may find lodgment in any part of the peripheral arterial or capillary systems.

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